Heidrun

General Presentation
HALTENBANKEN VILLAGE 2015
General introduction to Heidrun

Heidrun field history

- Discovered by Conoco in 1985
- Declared commercial in 1986
- Development approved by the Parliament in 1991
- Gas pipeline to Tjeldbergodden approved in 1992
- Started production 18 October 1995
- Started gas export to Tjeldbergodden in 1997 - supplying a methanol plant
- First oil from the North Flank Development August 2000
- Gas export to Europe via Åsgard Transport from Feb. 2001
Heidrun field installations and infrastructure
Heidrun process capacities

<table>
<thead>
<tr>
<th>Phase</th>
<th>Current capacities</th>
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</thead>
<tbody>
<tr>
<td>Total liquid [Sm³/d]</td>
<td>48 500</td>
</tr>
<tr>
<td>Oil treatment [Sm³/d]</td>
<td>40 000</td>
</tr>
<tr>
<td>Produced water [Sm³/d]</td>
<td>32 000</td>
</tr>
<tr>
<td>Gas handling [MSm³/d]</td>
<td>6.3</td>
</tr>
<tr>
<td>Gas export – Tjeldbergodden [MSm³/d]</td>
<td>7.2</td>
</tr>
<tr>
<td>Gas export – Åsgard Transport [MSm³/d]</td>
<td>13.2</td>
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</tbody>
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Heidrun well slots

- TLP: 56 wells lots
- Subsea:
  - 2 production templates (8 wells)
  - 3 injection templates (12 wells)
Official in-place oil and gas volumes

<table>
<thead>
<tr>
<th></th>
<th>Low estimate</th>
<th>Base estimate</th>
<th>High estimate</th>
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<tbody>
<tr>
<td></td>
<td>P90</td>
<td></td>
<td>P10</td>
</tr>
<tr>
<td>Oil (MSm³)</td>
<td>357</td>
<td>432</td>
<td>520</td>
</tr>
<tr>
<td>Associated gas (GSm³)</td>
<td>30,4</td>
<td>36,7</td>
<td>44,2</td>
</tr>
<tr>
<td>Free gas (GSm³)</td>
<td>45,4</td>
<td>51,7</td>
<td>58,5</td>
</tr>
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</table>
Heidrun - Oil and gas production

- Total reserves
  - 190 MSm³ oil
  - 50 GSm³ gas
- Remaining reserves (Dec 2014)
  - ca 45 M Sm³ oil
- Production rates (Dec 2014)
  - ca 9 000 Sm³ oil/day
  - ca 6.0 M Sm³ gas/day
- Active wells (Dec 2014)
  - 15 wells in Fangst (7 prod, 7 WI, 1 GI)
  - 8 Upper Tilje (7 prod, 1 WI)
  - 29 Lower Tilje & Åre (22 prod, 7 WI)
Heidrun Stratigraphy

- Early to Mid Jurassic Reservoir
- Complex faulting, many compartments and contacts
- 5 main group of reservoir zones
  - Most mature reservoirs – challenge: locate remaining oil
    - Fangst Gp. (Garn & Ile)
    - Upper Tilje Fm.
  - Less developed, large IOR potential, fluvial channels in Lower Åre
    - Lower Tilje & Upper Åre
    - Middle Åre
    - Lower Åre
- Cretaceous to Tertiary overburden
  - Cretaceous sands
Heidrun drainage strategy - overview

• Start production: 18 October 1995

• Down flank water injection
  – Sea water injection (stopped 2014)
  – PWRI (Produced Water Re-Injection)
  – SRP from 2003 (Sulphate Reduction Plant) to mitigate scaling

• Gas injection
  – Re-injection of gas in the Fangst gas (A-38)

• Increased gas export from 2016

• Reference case TLP drilling throughout 2039
Heidrun drainage strategy – overview (continued)

• **Water injection is the primary drainage**
  – Maintenance of the reservoir pressure
  – Water flooding considerably better than pure depletion

• **Re-injection of free gas in the Fangst gas cap**
  – Maintenance of the reservoir pressure
  – Gas flooding of the area between the gas cap and the Fangst and Upper Tilje producers on the south flank
  – Want a drainage strategy that is robust with respect to the uncertainty in fault transmissibility

• **Combination of several reservoir zones with different reservoir quality**
  – Water shut-off after water breakthrough

• **Perforate the water injectors to inject in several reservoir zones**
  – One injector supports two producers

• **Do not want increased viscosity of the oil**
  – Keep reservoir pressure up to avoid unfavourable mobility ratio